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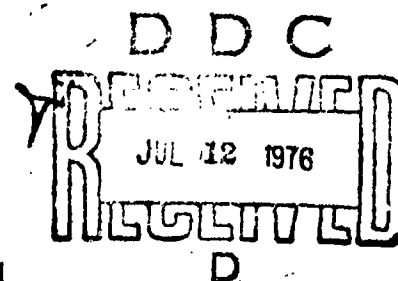
**TESTING OF M84A1 TIME FUZE
WITHOUT C PELLETS**

**SAMUEL KAHN
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JUNE 1976

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18. KEY WORDS (Continue on reverse side if necessary and identify by block number) Fuze, Time, M84A1 Transfer pellet Elimination		
19. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report represents the result of a series of tests performed on the M84A1 fuze used on 81 mm illuminating cartridges. The fuzes were modified by removal of the type C pellet from the graduated time train rings and by substituting cored B pellets. Static testing at both 20- and 30-second settings yielded no failures due to non-transfer of ignition from the upper to the graduated time train rings in 1200 fuzes tested. The feasibility of eliminating the C pellet was verified.		

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BACKGROUND

The M84A1 (see Fig 1), for use on the M301A3 81 mm illumination cartridges, is a pyrotechnic time fuze settable from 0 to 50 seconds. The primer initiates functioning by igniting the type A pellet in the upper time train ring. This in turn sets off the tungsten delay powder which burns a predetermined amount of time depending on the set time. The B pellet in the graduated ring is then ignited and transfers to the tungsten delay powder via the C pellet. The D pellet in the body is ignited next and sets off the black powder explosive charge which causes candle separation and ignition.

Prior to 1968 the pellets (A through D) were of zirconium nickel composition. Since this resulted in less than desired functioning of the fuze, the pellets were changed to boron-potassium nitrate composition. With the zirc pellets, both B and C pellets were required for proper ignition transfer. This is not the case with the BKNO_3 pellets which produce a hotter flame front. However, due to the South East Asia (SEA) situation, fuzes required for verification testing were not available. Fuzes were finally made available from rejected Maxson Corp fuzes.

Claims against the Government were initiated first by Maxson Corp in 1973, and then by Thiokol in 1975. They claimed that fuze duds were caused by failure of ignition transfer between the upper time train ring and the graduated time train ring due to the C pellet being ejected through the vent washer. A small number of exploratory tests were made without washers and C pellets. All test samples resulted in proper ignition transfer, thereby suggesting a technical weakness in the claim. Since the sample size tested was considered to be statistically small, a larger sample size was tested. The test results are detailed in this report.

TIME FUZE M84A1

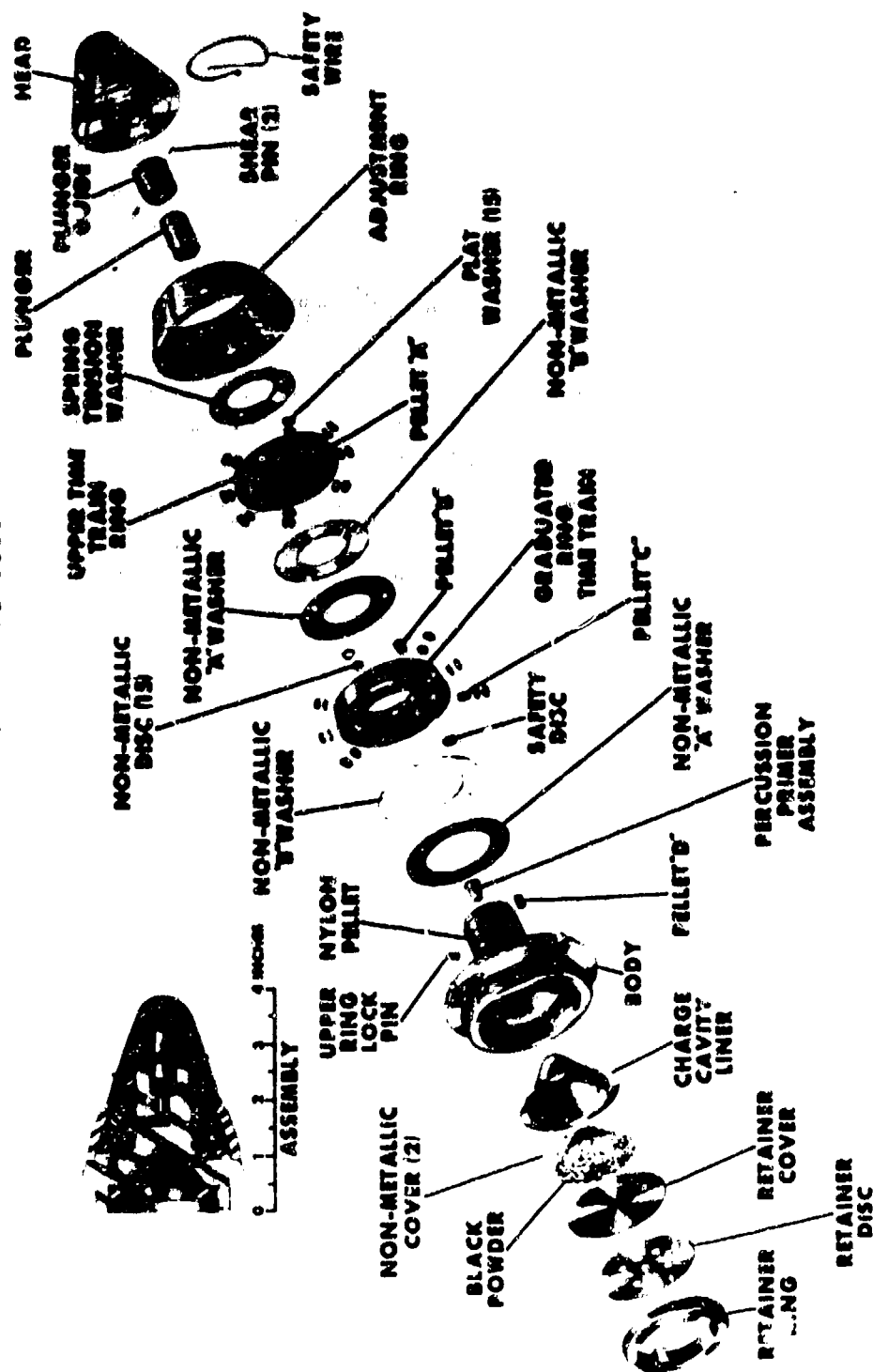


Fig 1 Time fuze M84A1

DETAILS OF TESTING

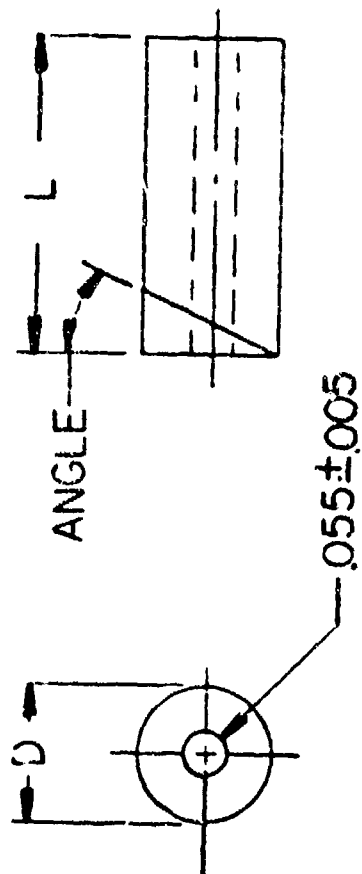
The fuzes used for these tests were manufactured by Maxson Corporation in 1973 and subjected to adverse storage conditions, i.e., fuzes were left out in the rain in open containers. To determine the usability of the fuzes after being exposed to these conditions, 300 fuzes were statically fired after removal of the window, vent washer, and C pellets (see Tables 1 and 2). Half the fuzes were fired at the 20-second and half at the 30-second setting, resulting in two duds. The two duds were caused by a missing D pellet and blockage of the transfer hole by a crumpled felt washer.

Additional testing of 900 fuzes was conducted using cored B pellets (see Fig 2) that produce a hotter and faster flame front for initiation of the tungsten delay powder. The core holes in all cases were 1.40 mm (0.055 in.) $\pm 0.13 \text{ mm}$ (0.005 in.). Prior to testing, the fuzes were disassembled and all pellets (A, B, C, and D) were removed. The graduated time train rings (see Fig 3) were modified by increasing the depth of the B pellet hole from 3.94 mm (0.155 in.) $+ 0.13 \text{ mm}$ (0.005 in.) to 4.83 mm (0.190 in.) $+ 0.13 \text{ mm}$ (0.005 in.). The fuzes were then reassembled with new A and D pellets, with three different B pellets (see following list), and without C pellets; also without C pellet washers and windows.

Using 300 B pellets from each of the three sources, 900 fuzes were assembled. The fuzes were statically tested, half at the 20-second and half at the 30-second settings. No duds were encountered. The irregularities in the burning time were due to the unfavorable storage conditions of the fuzes prior to shipment to the Arsenal.

CONCLUSIONS

The reliability demonstrated in each test group at both settings is 0.992 percent. This is comparable to reliability achieved in fuzes of the current configuration. Therefore, the results of the testing prove that the C pellet is redundant and can be safely removed to achieve proper ignition transfer from the upper to the lower time train rings.



PART NO.	PELLET	D	L	ANGLE
9234458-1	A	.161±.001	.217-.012	NONE
9234458-2	B	.161±.001	.217-.012	15°±1°
9234458-4	D	.161±.001	.182-.012	NONE
9234458-5	E	.202±.001	.337-.007	45°±5°

Fig 2 Pellets, Ignition 9234458

.190+0.005

15° REF

.217-.012 REF

IGNITION
B PELLETT
9234458-2

MOD. LDG.

MOD. M.P.

Fig 3 Graduated time train ring assembly 9232791

RECOMMENDATIONS

The C pellet should be eliminated, thereby reducing the cost of the fuze and avoiding handling of the pellet. Reduced handling would eliminate hygroscopic problems associated with the pellet, and consequently could lead to a reduction in the fuze dud rate.

The 5.51 mm (0.217 in.) - 0.30 mm (0.012 in.) length B pellet should be used even though all pellets functioned uniformly. The longer pellet will bring the flame front closer to the tungsten delay powder, thereby assuring a better transfer of ignition.

The drawings for the B pellet (9234458) and graduated time train ring (9232791) should be modified in accordance with the dimension in Figures 2 and 3.

Table 1

M84A1 fuze function time
 Lot MSO 1-8
 Production fuze for control
 Pellet C removed

Fuze setting: 20 seconds

19.75	19.95	16.20
19.27	18.30	20.15
18.44	20.47	20.21
18.90	19.59	
18.37	14.39	
15.65	15.82	
19.28	16.45	
19.62	18.41	
19.75	19.48	
18.42	19.58	
18.84	12.98	
18.58	19.27	
18.84	19.28	
19.28	19.27	
20.24	19.05	
15.77	18.78	
19.33	19.78	
19.59	19.05	
19.45	19.08	
19.63	19.83	
19.66	19.72	
12.15	17.31	
DUD	19.04	
20.08	15.35	
20.30	19.92	
19.40	19.87	
19.17	20.11	
19.04	19.29	
19.50	19.15	
19.46	19.34	
16.55	19.99	
20.20	19.80	
19.70	19.60	
19.68	19.95	
14.21	20.97	
20.07	19.46	

Table 1 (Continued)

Fuze setting: 30 seconds

25.26	29.98
29.25	28.68
28.71	29.34
29.62	29.36
29.71	28.49
29.12	29.01
28.75	28.84
28.35	29.09
29.00	28.85
29.34	28.82
29.48	28.68
28.72	20.75
28.31	29.01
29.00	28.54
28.69	29.26
29.07	28.46
29.42	18.30
29.27	28.53
29.15	29.22
28.92	28.87
28.74	29.51
28.59	30.05
28.91	25.78
28.36	21.33
29.18	28.77
29.43	29.22
29.29	28.99
29.07	29.62
29.22	28.59
29.54	29.65
30.15	28.92
30.21	29.18
28.97	28.80
29.81	
29.57	
28.42	
28.85	
29.62	
28.92	
29.28	
29.24	
29.55	

Table 2

NB4A1 fuze function time
 Lot MSO 1-9
 Production fuze for control
 Pellet C removed

Fuze setting: 20 seconds

18.91	19.63
19.68	20.17
19.67	19.55
19.66	19.20
19.65	19.06
19.74	19.34
19.10	19.07
19.32	20.09
19.67	18.71
19.65	19.40
19.52	19.58
19.27	19.43
20.04	19.35
19.78	19.55
18.65	19.59
19.45	19.32
19.69	20.17
20.61	18.75
20.06	19.39
20.20	19.57
19.20	18.70
18.92	19.97
19.70	19.57
20.16	19.60
20.12	20.27
19.44	19.63
18.80	19.90
20.09	19.86
18.71	20.41
20.65	19.04
19.11	19.53
19.17	18.36
19.86	19.18
12.77	19.17
19.56	19.50
19.95	18.95
20.44	19.40
	20.30

Table 2 (Continued)

Fuze setting: 30 seconds

28.95	28.91
29.74	29.55
28.89	29.21
29.18	28.85
28.98	28.79
28.92	28.68
29.50	DUD
28.63	28.29
29.07	29.39
28.30	28.44
28.35	28.71
29.80	28.84
28.91	29.03
28.73	28.44
29.20	29.22
28.82	28.60
29.21	28.05
28.41	29.09
28.65	29.13
29.50	28.66
28.68	28.67
29.50	28.65
28.34	28.79
29.23	29.30
DUD	28.74
28.74	28.62
29.23	28.77
29.22	29.15
29.49	28.77
29.23	29.75
29.23	28.78
28.80	27.95
29.41	29.20
28.55	
28.75	
28.94	
29.86	
29.45	
28.89	
29.68	
28.74	
28.64	

Table 3

M84A1 fuze function
Group T-1
Picatinny pellets A, B, and D
B pellet 0.182 long

Fuze setting: 20 seconds

19.99	20.00	20.50	19.05	20.65
20.31	19.71	20.65	19.55	19.89
19.94	20.72	20.65	20.22	
20.60	19.63	20.26	20.07	
20.56	20.10	20.80	17.70	
20.81	20.25	20.93	20.45	
20.21	20.24	20.45	20.49	
21.03	19.94	20.96	20.37	
21.62	20.04	22.55	15.26	
21.55	20.73	20.60	21.65	
20.05	20.42	20.00	17.95	
20.62	20.84	20.81	20.82	
20.65	19.95	19.74	20.62	
19.68	20.92	20.47	20.26	
20.60	20.50	20.40	16.20	
20.03	19.84	20.54	19.87	
20.57	20.81	20.34	19.76	
21.00	20.14	20.45	18.50	
20.65	20.65	20.12	20.27	
20.82	20.22	19.51	15.04	
20.09	19.96	20.42	20.96	
21.62	20.47	20.15	20.65	
20.95	20.85	20.32	20.62	
21.85	21.46	21.15	20.33	
19.95	20.50	20.26	19.66	
20.29	20.59	20.51	20.51	
19.48	21.43	20.85	18.21	
20.78	20.70	21.60	20.11	
21.32	21.11	20.58	20.36	
20.70	20.01	20.74	20.42	
20.42	20.07	19.03	20.18	
20.55	19.85	21.21	20.67	
20.75	21.51	20.62	19.98	
21.30	20.65	19.78	21.19	
20.48	20.29	16.65	20.89	
20.33	20.05	19.70	18.30	
20.72	20.56	20.49	17.35	

Table 3 (Continued)

Fuze setting: 30 seconds

30.25	29.85	30.62	29.32
29.71	29.70	28.09	29.82
29.98	29.90	30.11	29.33
23.37	30.70	30.04	29.69
29.45	31.80	24.00	30.72
30.58	29.13	28.95	29.75
29.91	29.66	22.25	27.92
30.03	30.16	29.48	29.26
28.02	28.73	29.74	26.60
28.09	28.93	29.57	29.80
26.70	28.72	30.35	22.92
29.95	29.90	30.90	23.48
28.89	29.48	29.54	30.14
29.15	30.23	30.30	30.73
28.80	29.03	29.24	25.25
27.75	29.57	29.95	21.20
28.94	30.00	29.90	30.74
29.73	30.30	29.56	21.18
27.60	28.95	28.63	30.75
20.44	22.92	29.73	29.20
28.90	30.51	29.11	19.03
29.72	30.12	27.00	16.00
20.81	29.44	32.05	28.50
29.99	29.50	29.25	30.02
29.50	30.61	29.82	
28.97	29.69	22.69	
28.87	29.75	20.98	
29.90	29.97	30.01	
30.04	29.65	29.76	
28.90	30.17	25.32	
30.40	30.02	29.83	
28.65	30.15	29.45	
29.42	30.29	23.50	
28.58	25.89	31.00	
29.10	31.12	29.95	
29.90	29.88	29.35	
24.23	30.13	30.38	
29.96	30.65	30.15	
29.99	29.00	29.51	
29.52	29.14	30.25	
29.83	30.40	29.20	
30.08	29.70	30.26	

Table 4

M84A1 fuze function
Group T-2
Picatinny pellets A and D
PSI pellet B 0.217 long

Fuze setting: 20 seconds

22.37	21.30	20.00	19.10
19.75	19.45	20.52	20.28
20.82	20.76	19.64	20.19
19.41	20.38	20.61	19.80
19.29	20.35	20.27	20.36
19.44	20.51	21.03	20.05
20.09	20.58	20.02	19.75
20.52	20.24	16.11	19.92
19.39	20.49	19.84	19.41
19.50	20.57	19.99	19.68
19.65	19.82	20.38	20.18
20.12	20.08	20.56	19.50
14.94	20.34	19.21	20.25
19.52	20.05	20.03	15.61
20.21	20.35	20.55	19.68
21.16	20.24	19.32	19.65
19.89	20.06	19.78	20.49
20.05	16.25	19.34	19.87
18.39	19.92	19.49	15.87
20.15	20.32	17.60	19.93
19.70	20.14	19.15	20.27
19.63	19.56	19.48	19.95
19.77	19.78	20.01	19.87
19.96	16.08	20.16	20.83
19.76	20.04	20.92	18.43
19.56	20.57	19.65	20.85
20.26	19.68	20.39	20.44
20.06	19.57	19.73	20.07
19.42	20.40	20.58	20.13
20.05	19.74	19.65	20.25
19.59	19.02	19.30	20.68
20.15	20.55	20.26	20.35
19.73	20.33	20.51	20.32
18.62	20.56	19.80	14.61
20.23	20.75	16.04	19.78
19.75	18.75	20.18	20.02
20.32	20.27	20.81	
18.42	19.78	18.32	

Table 4 (Continued)

Fuze setting: 30 seconds

30.58	29.10	30.35	29.65
39.15	29.25	30.15	30.14
29.34	29.00	30.25	28.50
29.46	30.35	29.72	29.92
29.23	28.98	29.90	22.38
23.88	29.02	29.05	23.58
29.20	28.89	30.49	29.47
29.30	30.00	30.36	29.02
28.73	24.75	29.88	26.67
29.99	29.90	29.80	29.34
28.73	29.66	23.50	29.94
29.83	29.38	30.40	30.72
29.68	29.80	30.16	32.23
29.23	29.88	30.98	30.09
29.24	26.52	30.52	31.02
29.67	30.00	30.28	29.88
29.20	30.72	29.70	30.36
29.34	29.65	30.02	29.77
28.94	24.60	28.40	30.02
29.14	30.62	29.21	30.95
29.72	30.48	30.92	30.68
30.35	29.42	29.02	30.12
29.35	30.42	29.47	29.90
30.19	29.35	30.21	20.46
30.08	29.53	29.69	
29.62	29.41	22.90	
29.12	29.44	29.57	
29.14	27.27	29.67	
29.30	30.41	30.10	
30.08	29.72	30.60	
29.65	30.45	30.10	
29.28	30.17	30.67	
30.22	30.76	25.38	
29.77	30.45	29.59	
29.86	29.78	26.28	
29.18	30.16	29.23	
30.29	30.40	29.41	
29.13	29.77	28.86	
28.97	30.20	29.45	
30.40	30.14	29.39	
29.48	26.24	29.38	
30.70	29.73	29.50	

Table 5

M84A1 fuze function
 Group T-3
 Picatinny pellets A and D
 Celesco pellet B 0.215 diameter

Fuze setting: 20 seconds

20.92	20.22	19.57	20.35	18.10
19.92	19.55	19.83	19.56	19.11
20.75	19.36	20.00	19.84	
20.07	19.01	19.45	19.07	
20.62	19.93	20.37	19.61	
19.76	19.21	20.16	19.44	
19.77	19.28	20.20	19.95	
19.99	18.80	20.14	19.63	
20.32	19.42	19.87	19.90	
19.82	19.25	20.36	19.40	
19.43	19.76	21.14	20.19	
19.96	19.27	18.87	19.15	
19.88	19.95	19.64	20.17	
20.25	20.06	19.27	20.45	
20.03	19.85	20.12	20.14	
20.95	19.24	19.05	19.87	
19.72	19.32	19.58	20.35	
19.35	20.37	19.32	19.79	
19.10	19.08	20.06	19.84	
19.42	19.14	18.50	19.54	
20.43	20.61	20.15	18.71	
20.00	19.05	19.97	19.63	
19.11	19.44	20.06	20.57	
19.46	19.50	19.03	20.72	
18.66	19.95	19.73	20.40	
19.24	19.12	19.92	20.27	
19.79	20.34	20.00	20.16	
20.00	19.58	19.37	21.27	
19.72	19.28	20.32	19.70	
19.47	20.18	18.72	20.34	
20.12	19.59	19.60	20.52	
20.59	19.36	19.55	19.73	
18.66	19.74	20.29	19.99	
19.77	19.21	19.60	19.83	
19.33	19.43	19.79	20.51	
19.14	19.95	20.01	20.37	
20.41	19.82	19.53	19.70	

Table 5 (Continued)

Fuze setting: 30 seconds

28.86	29.17	22.47	28.95
29.80	29.40	28.34	29.50
29.48	29.95	29.46	29.67
29.37	29.45	29.23	29.38
29.28	29.82	30.21	29.48
29.12	29.32	29.50	29.70
30.00	29.28	29.32	29.32
29.55	19.32	28.80	29.79
29.30	29.45	28.05	28.47
29.09	29.52	28.79	29.05
24.40	28.68	29.01	30.26
29.31	29.86	29.70	29.35
29.12	29.87	29.21	29.15
29.91	29.65	29.89	29.20
29.87	29.31	29.38	30.00
29.72	29.56	30.32	29.88
28.70	29.27	28.80	29.15
29.56	28.67	29.40	29.30
28.98	30.03	29.67	30.06
29.76	29.35	29.30	29.78
28.96	29.42	30.19	30.60
29.30	28.80	29.70	29.21
28.76	28.79	29.60	29.77
29.30	28.95	29.15	29.37
29.80	30.11	28.83	
29.47	29.91	29.11	
28.91	29.40	29.25	
29.18	29.21	29.38	
23.49	29.75	29.25	
28.80	29.10	29.37	
29.58	29.15	29.56	
29.51	30.56	29.22	
28.79	29.38	28.85	
29.37	30.09	29.57	
29.50	29.76	30.12	
29.55	29.20	28.65	
28.03	29.92	29.32	
23.34	29.62	29.05	
29.20	29.73	28.90	
29.97	29.11	30.02	
29.91	30.00	30.27	
29.15	29.27	29.51	

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